FOOD AND FEEDING HABITS OF WILD AND REARED GILTHEAD BREAM *SPARUS AURATA* L.

by

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RÉSUMÉ. – L'examen des contenus stomacaux de daurades sauvages ou d'élevage, *Sparus aurata* (Sparidae), des eaux méditerranéennes d'Egypte ou de piscicultures, ne montre aucune différence dans le comportement alimentaire des poissons quelle que soit leur provenance. Leur régime très variable dépend surtout de la taille des poissons et de la disponibilité en nourriture. Crustacés, mollusques, polychètes, échinodermes et téléostéens forment l'essentiel des proies. L'alimentation a été comparée aux tailles, aux mois de capture et à l'habitat. Les résultats sont comparés entre les différentes daurades sauvages et les daurades d'élevage.

ABSTRACT. – Examination of the gut contents of wild and reared *Sparus aurata* (Family Sparidae) from the Egyptian Mediterranean waters and fish farms revealed no difference in their feeding habits. The diet, which was extremely variable, depended largely on size of fish and food availability. Crustaceans, molluscs, polychaetes, echinoderms and teleosts formed the major food items. Feeding was examined in relation to size, month and habitat. Results for both wild and reared fish were compared.

Key-words : Sparidae, Pisces, *Sparus aurata*, feeding behaviour, Egypt Arab Rep., MED Eastern Mediterranean.

The gilthead seabream *Sparus aurata* is one commercially important food fish in Egypt. It was among the selected fish species for farming in brackish water ponds. A thorough study on its different biological characteristics was then conducted (Wassef, 1978). Information on food and feeding habits of this fish in local waters is of utmost value to provide optimum nursery requirements for their successful rearing in fish farms. The aim of the present work was to analyse the food taken and to examine the feeding in relation to fish size, sex, habitat and month for both wild and reared fish.

MATERIAL AND METHODS

Wild fish samples were collected monthly from the landing centre of fishing boats along Alexandria coast from July 1975 to January 1977 (19 months). Fish

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were obtained fresh and subsequently examined. Reared fish specimens were taken alive monthly, by netting, from Rattama ponds (220 km east of Alexandria). 575 wild fish and 64 reared ones ranging in length between 5 and 51 cm were sampled.

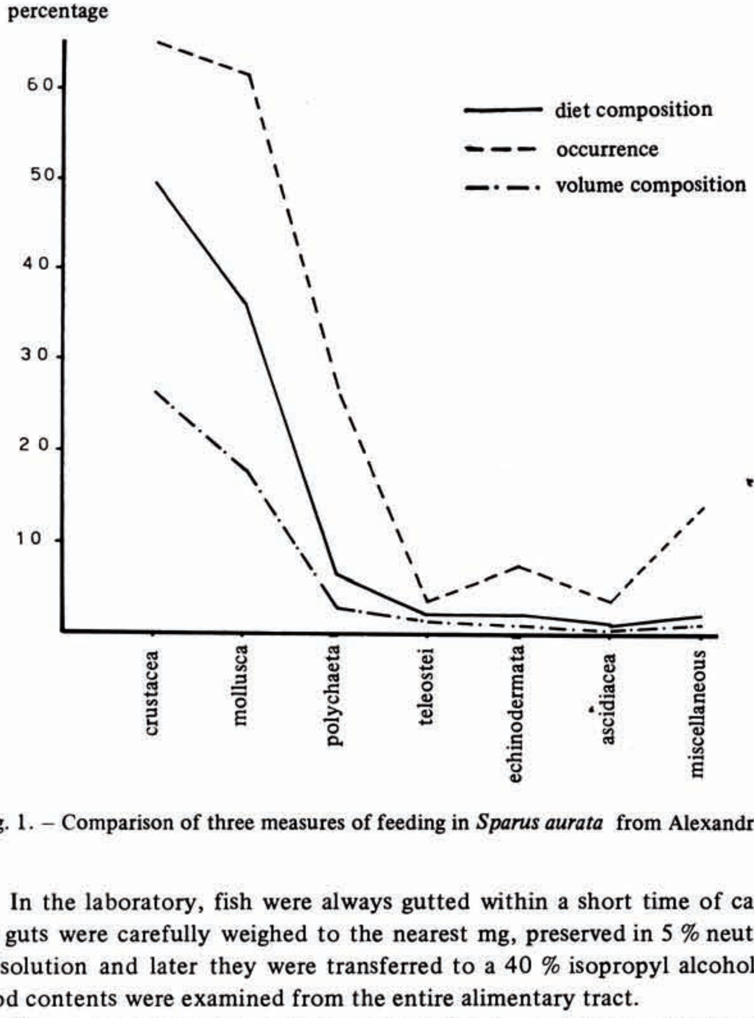

Fig. 1. – Comparison of three measures of feeding in *Sparus aurata* from Alexandria waters.

In the laboratory, fish were always gutted within a short time of capture and the guts were carefully weighed to the nearest mg, preserved in 5 % neutral formalin solution and later they were transferred to a 40 % isopropyl alcohol solution. Food contents were examined from the entire alimentary tract.

The most commonly applied methods for food analysis, after Hynes (1950) and Thompson (1959), are : the number method, the points and the occurrence method. In the present work the last two methods were adopted. In the points method, points were allotted to each food item according to its volume. A full tract received 20 points and an empty tract zero points, with intermediate values. Food items were identified whenever possible to family, sometimes species. The level of identification depended on the completeness of food organisms and the extent of digestion. The food points allotted were then divided among the various groups in the bulk sample.

In case of occurrence method, the occurrence of each food species, irrespective of its quantity, in each fish gut was recorded. From these methods three different statistics were derived measuring food composition for *S. aurata* :

Percentage of occurrence

This statistic is obtained by dividing the number of fish containing a given food item by the total number of fish examined in the sample. This statistic measures the food availability to the fish and also the selection of food by the fish if the local benthic fauna is known.

Percentage of diet composition

Food points for each food item are summed and divided by the total number of food points awarded to all fish analysed in the sample. This statistic gives the relative volume of food items making up the fish diet.

Percentage of volume composition

Food points for each food item category are summed and divided by the total potential alimentary volume (obtained by multiplying the number of fish examined by 20, the value for a full alimentary tract). This statistic gives the percentage of gut volume occupied by each food item.

RESULTS

General pattern of feeding (from the percentage of diet composition) :

Results of analysis for wild *S. aurata* are shown in table I. It appears that only about 52 % of gut volume was occupied with food. This indicates the extent of feeding activity of fish, which might also reflect food availability. Crustaceans, molluscs, polychaetes, echinoderms and teleosts form the main food items of this species in Alexandria waters. Other food items like ascidians, algae and bryozoa are occasionally found in the guts examined. *S. aurata* appears to occupy a very broad feeding niche in the benthic habitat.

Table I. – Various main food items eaten by *Sparus auratus* in Alexandria waters, in percentages.

Method of Analysis	Crustacea	Mollusca	Polychaeta	Teleostei	Echinodermata	Ascidiacea	Miscellaneous	Total %
Diet composition	49.8	35.6	6.5	2.8	2.4	0.9	2.0	100
Occurrence	65.2	61.5	20.7	4.2	7.7	3.8	14.1	–
Volume composition	26.4	18.1	3.3	1.6	1.1	0.6	0.9	51.9

Crustacea

Crustacea are the largest group in *S. aurata* diet, constituting about 50 % of all food consumed (table I). Crustacean food was mainly composed of six groups, namely : barnacles, crabs, prawns, isopods and thalassiniodes, together with some unidentified crustacean particles. Barnacles (Cirripedia, Thoracica, Balanidae), constituted 31 % ; crabs (Decapoda, Brachyura) 24 % ; prawns (Decapoda, Macrura, Natantia) 23 % ; isopods (Isopoda) 15 % of the total crustacean food. Two families of isopods were identified : family Idoteidae (Valvifera) formed the majority of isopods eaten and family Oniscoidae of which only three individuals were listed and identified as *Tylos* spp. Last come the Macrura Reptantia (Decapoda, Thalassinidae), *Upogebia* spp.) and crustacean remains making up 2.7 % and 2.6 % of crustacean food respectively.

Mollusca

Mollusca contributed about 36 % of total composition of *S. aurata* food. Bivalves and gastropods accounted for 74.8 % and 23.7 % of the total molluscan food respectively. Other molluscan food items made only minor contributions, namely squids (Cephalopoda Sepiidea) and Scaphopods (Scaphopoda, Dentiliidae, *Dentilium* spp.), but made only 1.1 % and 0.4 % of the molluscan eaten respectively. The following nine families of bivalves were recognised, according to their order of dominance : Ostreidae, Mytilidae, Pteriidae, Veneridae, Anomiidae, Donacidae, Cardiidae, Pectinidae, and Arcidae. While the gastropod families were : Fissurellidae, Patellidae, Trochidae, Turbinidae, and Turritellidae.

Polychaeta

Both errant (Aphroditidae and Eunicidae) and sedentary polychaetes (Arenicolidae) were observed in the guts examined, contributing a further 6.5 % to the total bulk of food consumed by *S. aurata*.

Teleostei

This class formed only 2.8 % of the diet. Only four species of fish could be identified, namely : *Mullus* spp. (Mullidae), *Saurida* spp. (Sauridae) and *Siganus* spp. (Siganidae). The other teleosts recorded, from which only skulls, fins and vertebrae could be recognised were too digested to be identified.

Echinodermata

They contributed 2.4 % to the bulk of food eaten by *S. aurata*. The most important group of which were sea-urchins *Echinus* spp. and *Cidaris cidaris* (Echinoidae) while brittle-stars (Ophiuroidea) and sea-cucumbers (Holothuroidea) occurred only twice and once respectively.

Tunicates

From this Phylum only ascidians were eaten representing a small percentage of the diet (0.9 %). Two families could be identified : Ascidiaceae and Stylidae.

Miscellaneous

This category includes algae, bryozoa, fish scales, eggs and unidentifiable materials. Among the algae found : *Ulva lactuca* (L.), *Corralina mediterranea, Laurencia obtusa,* and *Laminaria rodrigue*. It seems likely that these algae were taken accidentaly in *S. aurata* food.

Variation in feeding with fish-size

All fish examined were divided into six 5 cm-difference length groups, plus one length group for fish over 40 cm (41-51 cm) and the percentage occurrence and volume composition for each food item were calculated (tables II and III). Diet of small fish (10-15 cm) consisted mainly of polychaete worms, small bivalves and isopods. For the two size groups (16-20 cm and 21-25 cm) the major changes were an increase in the occurrence of bivalves and the first appearance of barnacles, crabs and prawns as well as a decrease in the occurrence of polychaetes, gastropods and isopods. As fish size increased a reduction in the occurrence of small, soft-bodies preys, e.g. polychaete worms, gastropods and small crustaceans, and an increase in barnacles, crabs, echinoderms and ascidians were noted.

Visual examination suggest that as *S. aurata* increase in size, so do their prey. Thus larger fish turn to larger food organisms and smaller must likewise feed on prey proportionate to their size.

Variations in the volume composition of food eaten by different sizes of fish (table III) illustrated that there was an increase in volume of food in the gut as fish grow in size until 25 cm. Thereafter, a decrease in this volume with size was noticed, reaching a minimum in the last size group (40-51 cm). As a general observation by the authors, *S. aurata* taken in early morning trawl hauls were fuller than those caught after dusk. It seems that food intake was greatest between 08.00 and 12.00 hours.

Seasonal variation

Monthly variations in the relative numbers of empty and filled guts as well as filling index (1) are shown in table IV. Of the 575 fish analysed, 501 (87.1 %) had food in their guts, while 74 only (12.9 %) had empty guts. A maximum feeding activity could be detected during April and May when about 95 % and 98 % of guts examined respectively were containing food. Highest percentage of empty guts was recorded in June (18.5 %) and in January (37.5 %) indicating a lower feeding rate during these months. From February to October fish feed moderately (low percentage of empty guts), while in November and December an increase in the percentage of empty guts was observed indicating a slightly lowered rate of feeding during winter months. High filling indices were recorded from February to October (5.4 - 6.6.) followed by a marked decrease in the next three months from November to January (3.3 - 4.1), i.e fish slow down their rate of feeding during winter

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(1) **Filling index : F.I. = 100 P / W, (Berhaut, 1973)
where P is the weight of gut content in g
and W is the gutted weight of fish in g**

Table II. Percentage occurrence of various food items according to size groups of wild *S. aurata* (between brackets are the number of fish analysed).

Length	No. of fish examined	Barna-cles	Crabs	Prawns	Isopo-ds	Thalat-hinoids	Crustac-ean remains	Total Crusta-cea	Bi-valves	Gastropo-ds	Squids	Scaph-opods	Total mollusca	Polych-aetes	Teleo-sts	Echino-dermes	Ascid-ians	Miscell-aneous
10-15	16				0.3 (4)		0.3 (4)	0.5 (8)	0.5 (8)	0.4 (7)			0.6 (10)	0.6 (9)			0.1 (1)	
16-20	81	0.1 (8)	0.3 (21)	0.3 (23)	0.2 (16)	0.1 (1)	0.1 (2)	0.7 (53)	0.6 (47)	0.2 (16)			0.7 (56)	0.2 (16)	0.1 (1)	0.1 (2)		0.1 (8)
21-25	247	0.3 (73)	0.3 (74)	0.3 (67)	0.1 (26)	0.1 (7)	0.1 (10)	0.7 (168)	0.7 (161)	0.2 (44)	0.1 (1)	0.1 (2)	0.7 (171)	0.2 (60)	0.1 (10)	0.1 (10)	0.1 (9)	0.1 (24)
26-30	171	0.3 (42	0.3 (50)	0.2 (34)	0.1 (22)	0.1 (3)	0.1 (8)	0.6 (103)	0.6 (95)	0.3 (45)	0.1 (1)	0.1 (3)	0.6 (108)	0.2 (27)	0.1 (11)	0.2 (28)	0.1 (2)	0.2 (25)
31-35	33	0.5 (16)	0.3 (9)	0.1 (4)	0.2 (6)	–	0.1 (3)	0.7 (22)	0.4 (14)	0.3 (10)	–	–	0.5 (17)	0.1 (4)	0.1 (2)	0.1 (2)	0.1 (2)	0.1 (3)
36-40	14	0.9 (12)	0.4 (5)	0.4 (5)	0.1 (1)	–	–	0.9 (13)	0.5 (7)	0.2 (3)	0.1 (1)	–	0.6 (9)	0.1 (2)	0.1 (1)	–	0.1 (1)	–
41-51	13	0.7 (9)	0.8 (10)	0.2 (2)	0.1 (1)	–	–	0.9 (12)	0.6 (8)	0.5 (7)	0.1 (1)	–	0.7 (9)	0.1 (1)	–	0.1 (1)	0.2 (3)	0.2 (2)

Table III. – Variations of different food items eaten by wild *Sparus auratus* (volume composition) with fish length

Length Group (cm)	No. of fish examined	Barna-cles	Crabs	Prawns	Isopo-ds	Thalat-hinoids	Crustac-ean remains	Total Crusta-cea	Bi-valves	Gastropo-ds	Squids	Scaph-opods	Total mollusca	Polych-aetes	Teleo-sts	Echino-dermes	Ascid-ians	Miscell-aneous	Total % of V. composit.
10.15	16	–	–	–	0.2	–	0.1	0.2	0.1	0.1	–	–	0.3	0.2		–	–	> 0.1	0.7
16.20	81	0.2	0.7	1.0	0.9	0.1	>0.1	2.8	1.4	0.5	–	–	1.9	0.5	0.2	0.1	–	0.1	5.6
20.25	247	3.4	3.5	2.9	1.4	0.4	0.3	11.9	6.7	1.2	0.9	>0.1	8.0	1.8	0.5	0.2	0.2	0.4	23.1
26.30	171	1.7	1.6	1.7	1.4	0.1	0.2	6.7	3.9	1.8	0.1	>0.1	5.8	0.7	0.7	0.8	0.2	0.3	15.1
39.35	33	1.4	0.3	0.2	0.3	>0.1	>0.1	2.3	0.6	0.3	–	–	0.9	0.1	0.2	>0.1	>0.1	0.1	3.6
36.40	14	1.1	0.1	>0.1	0.2	–	–	1.4	0.4	0.2	> 0.1	–	0.5	> 0.1	–	>0.1	–	> 0.1	2.0
41.51	13	0.6	0.3	>0.1	>0.1	–	–	0.1	0.3	0.3	0.1	–	0.7	> 0.1	–	>0.1	0.1	> 0.1	1.9

Table IV. – Monthly variations in the relative number of empty guts, guts containing food and filling index of *Sparus auratus* in Alexandria waters (1975-76).

Month	Frequency	Guts containing food		Guts empty		Filling * Index
		%	No.	%	No.	
January	48	62.5	30	37.5	18	3.8
February	75	88.0	66	12.0	9	6.4
March	28	89.2	25	10.71	3	5.56
April	65	95.38	62	4.62	3	5.95
May	57	98.25	56	1.75	3	6.24
June	27	81.48	22	18.52	5	5.43
July	53	92.45	49	7.55	4	5.77
August	52	88.46	46	11.59	6	6.09
September	41	87.8	36	12.2	5	6.00
October	18	88.89	16	11.11	2	6.63
November	19	84.21	16	15.79	3	3.26
December	92	83.69	77	16.30	15	4.07
TOTAL	575	87.13	501	12.87	74	

* $\text{F.I.} = \frac{P}{W}\, 100$

where P = weight of gut content in grams.

W = gutted weight of fish in grams.

months. Maximum F.I. values were detected in April and May indicating heavy feeding. These are in accordance with results obtained from the preceding analysis of empty guts.

Feeding of reared fish

Similarly, for *S. aurata* raised in brackish water ponds (Rattama farms), using the three statistical measures of feeding mentioned before, the general feeding pattern is shown in table V. Food consisted of small bivalves, fish fry, polychaete worms, gastropods, crustacean larvae and small crabs. Other food items of minor occurrence like copepods, small shrimps, ostracods, malacostraca and plant matter were also recorded. About 47 % of the gut volume was occupied with food, compared with about 53 % for wild fish. Molluscs formed the most important food item of reared fish (table V) representing about 40 % of the total composition of food eaten (compared with 35 % for wild specimens). The molluscan food comprised small bivalves (about 36 %) and gastropods (only 4 %), fish fry constituting about 26 % of food (compared with 2.8 % for wild fish). Polychaetes accounted for about 17 % of diet composition (6 % for wild fish).

Table V. – Food items in the gut contents of reared *Sparus auratus*, in percentages

Method of analysis	Biva-lves	Gastr-opods	Total molluscs	Pisces	Polyc-haetes	Crust-acean larvae	Copep-ods	Small crabs	Small prawns	Ostr-acods	Malaco-straceae	Total crus-tacea	Plants	Other food	Total
Diet Composition	36.0	4.2	40.2	25.9	16.9	2.8	0.9	1.9	0.7	0.5	0.5	6.2	1.4	9.5	100
Occurrence	67.4	13.0	80.4	37.0	39.1	13.0	6.5	2.2	2.2	2.2	2.2	21.7	10.9	50	–
Volume composition	17.0	2.0	19.0	12.2	7.9	1.3	0.4	0.9	0.3	0.1	0.1	3.2	0.7	4.5	47.3

Table VI. – Composition by volume of different food items in the guts of reared *Sparus auratus* of different length groups, in percentages
(between brackets : number of fish analysed)

Length group (cm)	Biva-lves	Gastr-opods	Total molluscs	Pisces	Polyc-haetes	Crust-acean larvae	Copep-ods	Small crabs	Small prawns	Ostr-acods	Malaco-straceae	Total crus-tacea	Plants	Other food	Total
10 - 15 (6)	–	–	–	0.9	1.6	0.5	0.2	–	–	0.1	0.1	1.0	0.1	0.8	4.4
16 - 20 (29)	9.6	6.7	10.2	9.1	6.3	0.5	0.2	0.9	0.3	–	–	2.0	0.5	3.6	31.7
21 - 26 (11)	6.7	1.4	8.2	2.0	0.8	0.2	–	–	–	–	–	0.2	–	0.1	11.2

Volume composition of the different food items was assessed for the three size groups separately in table VI. Diet of small fish (10-15 cm) consisted mainly of polychaete worms and small crustaceans principally copepods, ostracods, malacostraceans, beside fish fry. The composition of food in volume increased from 4.4 % to 31.7 % indicating increased feeding activity with the increase in size. Then, a reduction in the food from 31.7 % to only 11.2 % was observed as the size of fish increased further (table VI). It appears that reared *S. aurata* have an extremely variable diet, the constitution of which depends on the size of fish. Small fish feed on small and soft-bodied animals, and when their size increase they tend to eat larger and more hard-shelled preys.

DISCUSSION

The present study revealed that *S. aurata* appear to occupy a very broad feeding niche in both Alexandria waters and « Rattama » ponds. They take large variety of food organisms and no single animal dominate in their diet. When a certain food item or group becomes scarce, *S. aurata* turn to many alternate food sources, thereby reducing the effect of any temporary scarcity of food. This lack of food specialization no doubt accounts for their success in Rattama ponds.

The examination and evaluation of feeding by occurrence and bulk (using a modified points system) in wild and reared fish claimed that crustaceans, molluscs, polychaetes, teleosts, and echinoderms are the major groups of their food. However, the observed variations in diet of wild and reared fish appear to reflect differences in the food available in the two habitats.

Variations of the major food items with fish size (tables II, III and VI), besides visual observation, clarified that in general both small wild and reared fish eat small or relatively soft-bodied animals, e.g. polychaetes and small crustaceans. As their size increased the fish tended to eat larger and more hard-shelled animals, particularly barnacles, bivalves, and fishes.

Moreover, results indicated that there is a gradual decrease in the volume of ingested food as fish size exceeded 25 cm (tables III and VI). This suggests that small fish feed actively at a relatively higher rate than larger fish. Intensity of feeding is subject to seasonal changes, activity being rather low during winter months (December to February) than at other time of the year. The decrease in feeding rate during winter for immature (reared) and adult (wild) fish might be attributed to changes in water temperature and food availability rather than to the breeding effect of fish in such months. Mazzola and Rallo (1981) recorded a similar lower feeding activity of reared *Sparus aurata* in Italy during winter months. Also, Wassef and Abu El Wafaa (1985), proved that *S. aurata* farmed in Egypt feeds at a lower rate during winter, December to February, when water temperature was below 16°, even if the food is given in sufficient quantity.

It may be worthy to mention in connection with the subject the work of Suau and Lopez (1976) on *S. aurata*.

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